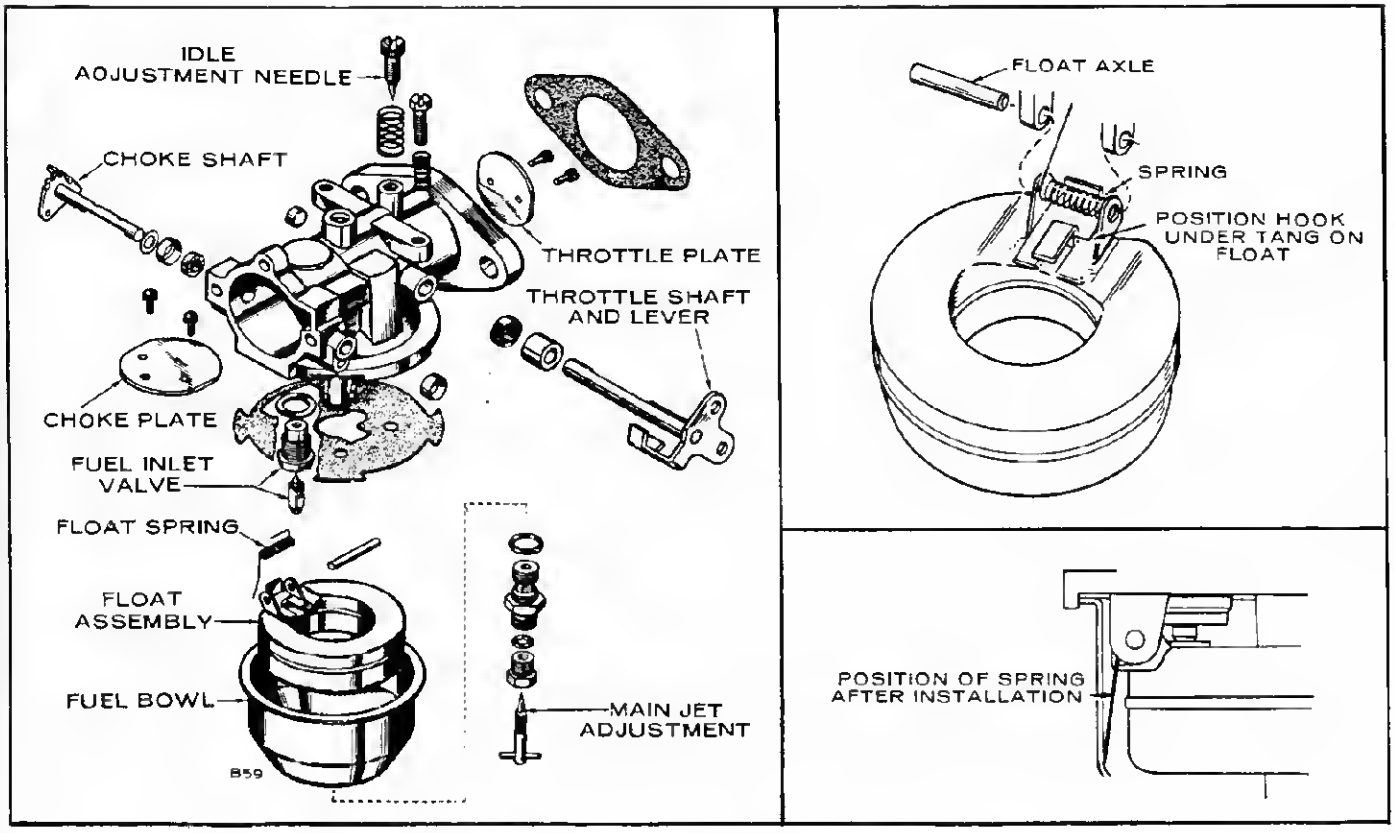


FIGURE 8a. SIDEDRAFT CARBURETOR ASSEMBLY

4. Check the condition of any needle valve not included in repair kit and replace if damaged (Figure 8b). Replace float if loaded with fuel or damaged.
5. Check the choke and throttle shafts for excessive play in their bore, and replace if necessary.
6. Replace old components with new parts included in repair kit.

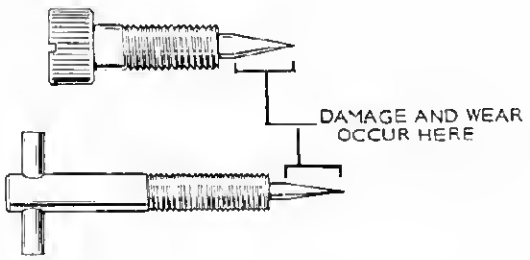


FIGURE 8b. MIXTURE NEEDLE INSPECTION

Reassembly and Installation

1. Install needle valve and seat, fuel bowl gasket, and float assembly. Make sure that all clips and springs are properly placed and that the float moves freely without binding. Check float level and adjust as necessary (see *Float Level Adjustment*).
2. Rejoin upper and lower carburetor sections on downdraft carburetors — fuel bowl and upper carburetor body on sidedraft models.

WARNING ***Fuel leakage is a fire and explosion hazard that might cause severe personal injury or death. Use care when reassembling carburetor. All parts must align perfectly or carburetor will leak fuel.***

The float spring on Zenith sidedraft carburetors rides on the inner face of the fuel bowl. Be sure to catch the end of the spring when reinstalling the bowl (Figure 8a).

3. Slide in throttle shaft and install throttle plate, using new screws if furnished in repair kit. Before tightening the screws, the plate must be centered in the bore. To do so, back off the throttle stop screw as necessary and completely close the throttle lever. Seat the plate by tapping with small screwdriver, then tighten screws. Install the choke shaft and plate in the same manner.
4. Install main and idle mixture screw assemblies. Turn in screws until lightly seated and then out the number of turns specified.

CAUTION ***Forcing the mixture adjustment screws tight will damage the needle and seat. Turn in only until light tension is felt.***

5. Reinstall carburetor on engine and connect fuel lines, linkages, and wires.
6. Reset mixture screws according to directions given earlier in this section. Install air cleaner adapter, where used, and air cleaner.

FUEL PUMP TEST

Test the fuel pump by checking the pump outlet pressure. Use the following procedure.

1. Remove the fuel line from the pump outlet and install a pressure gauge.
2. Press the START switch and hold it for several seconds until pressure reading is constant.
3. Pressure reading should be 2-1/2 to 3-1/4 psi (17.2 to 22.4 kPa). If the retension is good, the pressure should stay constant or drop off very slowly.

A low pressure reading with little or no pressure drop indicates a weak or broken diaphragm or diaphragm spring, worn linkage or leaky check valves. If pressure is above maximum, the pump diaphragm is too tight or the diaphragm (or plunger) return spring is too strong. Any of the above conditions are cause for repair or replacement of the pump.

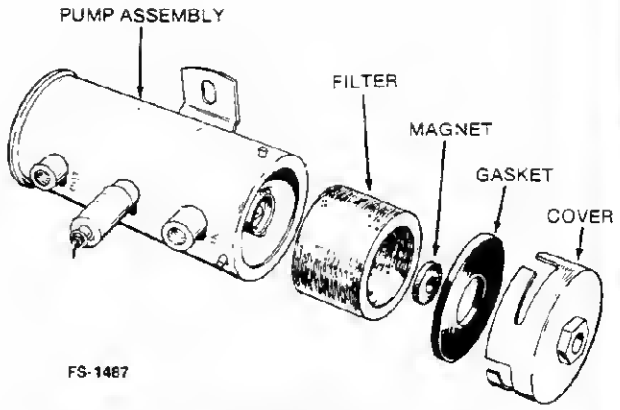


FIGURE 9. REMOVAL OF MAGNET AND FILTER

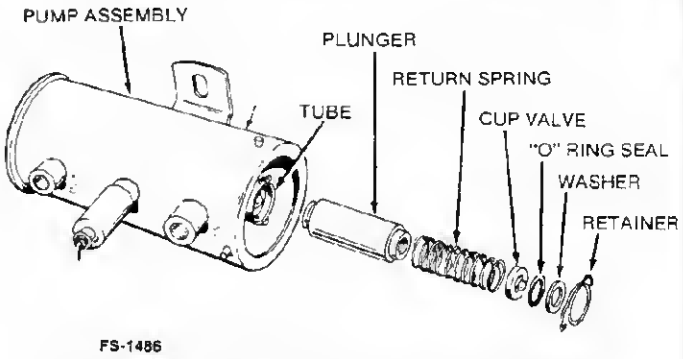


FIGURE 9a. REMOVAL OF PLUNGER ASSEMBLY

ELECTRIC FUEL PUMP

The Facet and Bendix pumps incorporate a hollow stainless steel plunger in a brass cylinder. The plunger has no gland or seal, but is freely fitted. The fluid being pumped provides the seal by filling the small clearance between the plunger and cylinder. Energizing the pump's electric solenoid pulls the plunger downward, compressing the return spring. When the solenoid is de-energized, the return spring drives the plunger back, delivering fuel to the pump outlet.

WARNING ***Do not substitute automotive type electric fuel pumps for standard Onan supplied electric pumps. The output pressure is much higher and can cause carburetor flooding or fuel leakage, creating a fire hazard.***

Fuel Pump Repair

Service of the Facet pump is limited to the bottom cover, filter, plunger tube, and plunger assembly. All parts of the electric system are hermetically sealed in a gas atmosphere and are not serviceable. If electrical failure occurs, replace the pump.

CAUTION ***Do not tamper with the seal at the center of the mounting bracket on the side of the pump as it retains the dry gas which surrounds the electrical system. Electrical system components are not serviceable.***

Use the following procedure for servicing the pump:

1. Using a 5/8-inch wrench, loosen, the pump cover, then remove by hand.
2. Remove the filter, magnet and cover gasket (Figure 9).
3. Using a thin nose pliers, remove the retainer spring from the plunger tube. Remove the washer, O-ring seal, cup valve, plunger spring and plunger from tube (Figure 9a).
4. Wash all parts (except gasket and seal) in parts cleaning solvent. Blow out solvent and dirt with low pressure compressed air. Slosh the pump assembly in cleaning solvent, blow dry and swab the inside of the plunger tube with a cloth wrapped around a stick. If the plunger does not wash clean or has rough spots, gently clean the surface with crocus cloth.

WARNING ***Most parts cleaning solvents are flammable and could cause serious personnel injury if used improperly. Follow the manufacturer's recommendations when cleaning parts.***

5. Insert plunger in tube, buffer spring end first. Check fit by slowly sliding the plunger back and forth in the tube. It should move fully without any tendency to stick. If a click cannot be heard as the plunger is slid from one end to the other, the internal pump assembly is not functioning properly and the pump should be replaced.
6. Install plunger spring, cup valve, O-ring seal and washer. Compress the spring and install the retainer with ends in the side holes of the tube.
7. Check cover gasket and replace if deteriorated. Place cover gasket and magnet in the bottom cover and install filter and cover assembly on pump. Twist cover on by hand and tighten securely with a 5/8-inch wrench.

MECHANICAL FUEL PUMP (Spec A-E)

A diaphragm type fuel pump is used. If fuel does not reach carburetor, check the fuel pump. Be sure there is fuel in the tank. If line is open and no fuel comes through, pump is defective. Failure of pump is usually due to a leaking diaphragm valve or valve gasket, a weak or broken spring, or wear in the drive linkage. Oil diluted with gasoline may indicate a faulty diaphragm.

Removal

1. Remove the fuel inlet and outlet lines from the pump.
2. Remove the two capscrews holding the pump to the engine.
3. Remove the pump, spacer (if used) and gasket from the engine and discard the gasket.

Installation

1. Remove all gasket material from mounting faces and spacer (if used). Apply oil-resistant sealer to both sides of the gasket(s) and to the threads of the attaching capscrews.
2. Place the gasket (and spacer if used) on the mounting face of the pump. Slide the mounting capscrews through the pump and gasket (and spacer) to prevent the gasket from slipping out of place.
3. Lightly place the pump in position on the engine, making sure the rocker arm is riding on the camshaft lobe. Start both capscrews and check for proper gasket placement. Alternately torque capscrews to specifications.
4. Connect the fuel inlet and outlet lines.
5. Operate the engine and check for leaks.

Repair

Repair kits are available that provide replacement parts for the pump which are most subject to wear. Use all parts included in the repair kit. Proceed as follows:

1. After the pump is removed from the engine, scribe a line on the flanges of the upper and lower pump bodies to assure correct positioning when reassembling.
2. Remove the securing screws and separate the upper and lower pump bodies.
3. Detach the valve cage retainer from the pump upper body. Noting their position, remove the valve and cage assemblies and their gaskets from the retainer (Figure 9b).

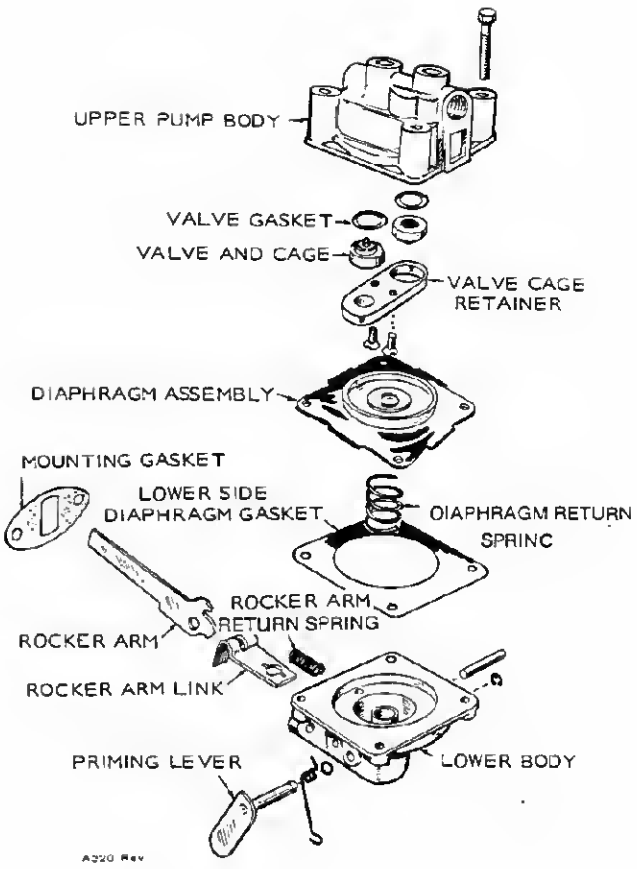


FIGURE 9b. EXPLODED VIEW OF PUMP

4. Detach the pump diaphragm by pressing its metal base into the pump body and turning it 1/4 turn. (Figure 9b).
5. The rocker arm return spring can normally be removed without removal of the rocker arm from the pump body. Use a small screwdriver or tweezers to compress the spring and tip it off the rocker arm catch. When installing the new spring, make sure it is properly placed before remounting the pump.
6. Clean in solvent all pump parts that will not be replaced and allow to dry.
7. Install the new valve and cage assemblies and their gaskets in the retainer. Be sure the assemblies are in proper position and fully seated. Reinstall the retainer and assemblies in the pump upper body.
8. To install the new pump diaphragm, turn the pump lower body upside-down and place the diaphragm and spring in the body. Press the base of the diaphragm up into the body of the pump and turn 1/4 turn.
9. Install new rocker arm return spring. Check for proper spring placement.

10. Place the upper and lower bodies of the pump together with the scribe marks aligned. Start the four securing screws, making sure they do not chew into the diaphragm fabric. Leave the screws 2 or 3 turns loose.

11. Operate the rocker arm several times to flex the new diaphragm. While holding the rocker arm fully flexed, tighten the body screws.

CAUTION ***Failure to flex the rocker arm fully while tightening the pump bodies together will result in excessive pump pressure and possible engine flooding or pump diaphragm failure.***

FUEL FILTER (Spec A-E)

Periodic maintenance should consist of cleaning the fuel filter, flame arrestor, carburetor, and complete carburetor adjustment.

Remove fuel sediment bowl, empty, clean, and dry (Figure 10). Remove screen and clean any trapped particles. When replacing the sediment bowl, be sure screen and gasket are in place.

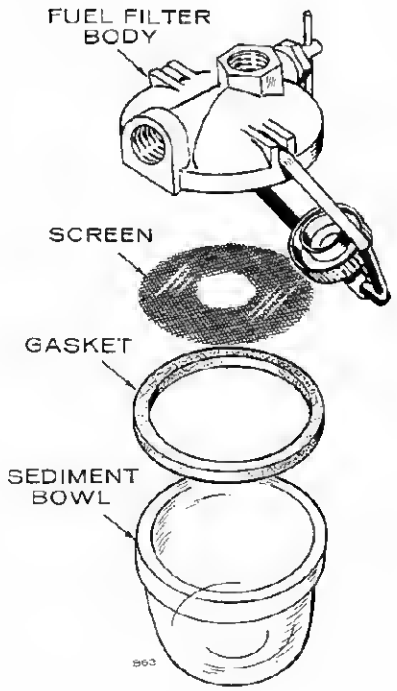


FIGURE 10. FUEL FILTER

FUEL FILTER (Begin Spec F)

Electric pumps incorporate a filter within the casing of the pump (Figure 10a). Use a 5/8 inch wrench to twist off the bottom of the pump and remove the filter element. If the filter is dirty, replace it along with the cover gasket.

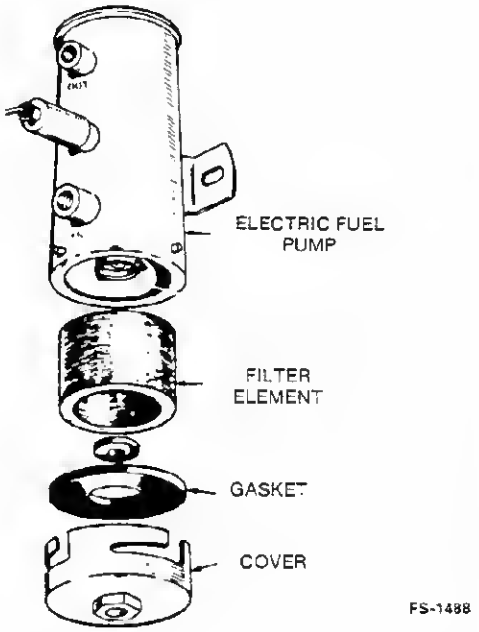


FIGURE 10a. BENDIX AND FACET ELECTRIC PUMP FILTER

AUTOMATIC CHOKES

Automatic chokes may occasionally require adjustment to provide the best fuel-to-air mixture for the existing temperature conditions. Several adjustments may be necessary to arrive at the correct setting. Let the engine cool to ambient air temperature between each adjustment.

If the engine starts, runs for a few minutes, then stops. the choke mixture may be too lean. If the engine starts, but runs rough and is sluggish once it has warmed up, the choke mixture may be too rich.

AMBIENT TEMP. (°F)	60	65	70	75	80	85	90	95	100
CHOKE OPENING (Inches)	1/8	9/64	5/32	11/64	3/16	13/64	7/32	15/64	1/4

FIGURE 11. THERMO-MAGNETIC CHOKE SETTINGS AND ADJUSTMENTS

Thermo-Magnetic Chokes (Spec A-G)

Thermo-magnetic chokes have a strip-type heating element attached directly to a bi-metal coil (Figure 11a). As the element heats, the coil twists and gradually opens the choke valve. An electromagnetic solenoid pulls the coil in tighter during engine starting to increase the choking effect. The coil is calibrated to provide the correct choke setting under various temperature conditions.

Adjustment: Adjustment of the choke setting must be made with the engine cold. Do not attempt adjustment until the engine has been shut down for at least an hour. Refer to Figures 11 and 11a and proceed as follows:

1. Loosen the screw which secures the choke body assembly.
2. Rotate the choke body until the correct choke setting is attained. Figure 11, lists the correct settings for various temperature conditions.
3. Start the engine and observe its operation. Slight readjustment of the choke setting may be necessary for best engine operation.
4. Retighten the securing screw when adjustment has been completed.

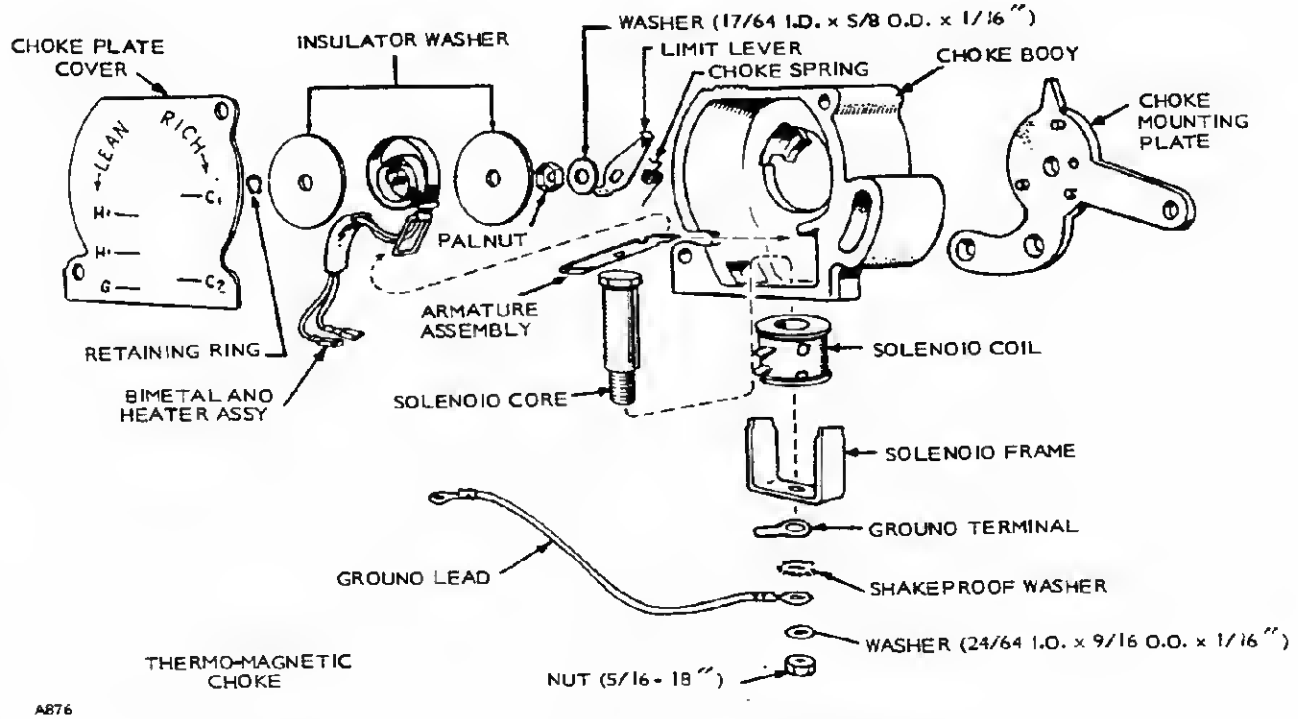


FIGURE 11a. THERMO-MAGNETIC CHOKE ASSEMBLY

Repair: If choke will not heat properly, check for broken heater wire, high-resistance connections, or broken lead wires to the bi-metal and heater assembly. With the element at room temperature, check the heater resistance with an ohmmeter. The resistance should be about 30.6 to 37.4 ohms for a 12 volt system. If the heater is defective, replace it with a new one. When the start button is engaged, the solenoid should cause the spring-loaded armature to contact the solenoid core.

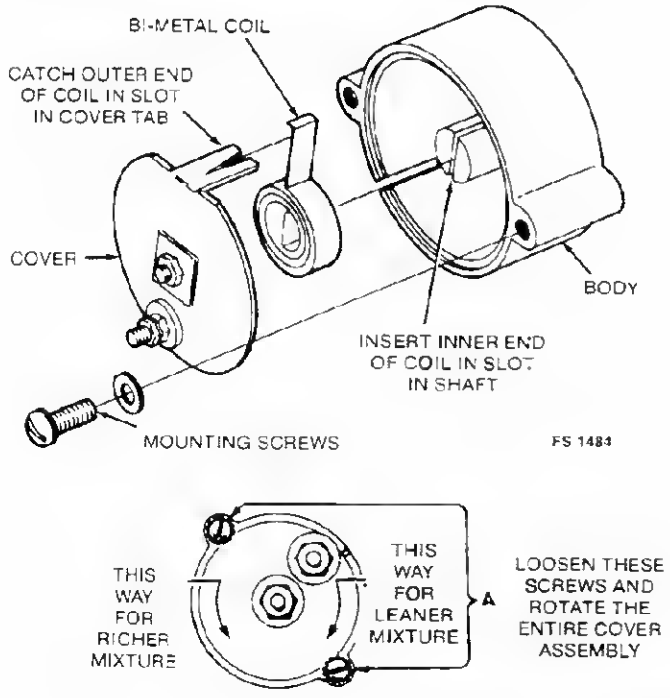
If this does not occur, check for broken lead wires or a defective solenoid coil. There must be slack in the lead wires between the choke body and the bi-metal and heater assembly. The solenoid coil resistance should be 2.09 to 2.31 ohms in a 12 volt system.

When replacing the cover on the thermostat and heater assembly, be certain that the choke heater lead wires have been correctly installed in the choke housing. Improper replacement of the lead wires can cause the choke assembly to malfunction.

The wires enter the choke assembly through a small notch that is cut in the edge of the housing. A cover holds the wires in place and prevents movement when tightened. When properly installed, the lead wires will hang freely under the bi-metal coil when the choke is in either the open or closed position. The end of the heater wire sleeve should be located from 1/8 inch inside the choke housing to flush with the inside wall.

When assembling the thermo-magnetic choke, the bi-metal and heater assembly is connected as follows:

1. Lead tagged G goes to ground terminal on coil solenoid.
2. Lead tagged H goes to either H¹ terminal on solenoid core.



ELECTRIC CHOKE

The choke consists of a bi-metal coil and an electric heating element. The bi-metal coil connects to the choke shaft and holds the choke plate nearly closed when the engine is cold.

As the engine starts, current is supplied to the electric heating element in the choke cover. Heat from the element causes the bi-metal coil to twist. The twisting action of the coil turns the choke valve shaft and gradually opens the valve. Heat from the element keeps the choke open while the engine is running.

WARNING ***The choke cover gets very hot during normal operation and can cause serious burns if touched. Do not touch the choke cover while the engine is operating.***

If the engine starts but runs roughly and blows out black smoke after a minute or two of operation, the choke is set too rich. If the engine starts but sputters or stops before it warms up, the choke is set too lean.

Adjustment: Table 2 lists average choke settings. Loosen the two mounting screws and rotate the choke cover until the correct setting is attained. Check the setting by starting the engine and observing its operation. Be sure to retighten the mounting screws after adjustment (See Figure 12).

TABLE 2. CHOKE SPECIFICATIONS

AVERAGE CHOKE SETTING	
AMBIENT TEMP	CHOKE OPENING
40° F 4.4° C	7/32 to 9/32 inch 5.6 to 7.1 mm
70° F 21° C	11/32 to 13/32 inch 8.9 to 10.4 mm

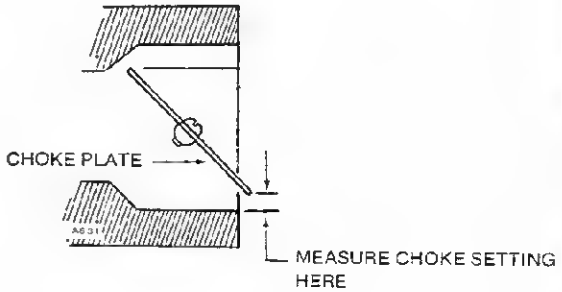


FIGURE 12. ELECTRIC CHOKE ADJUSTMENT

Repair: If the choke fails to operate, check to see if the heating element is working. If it is, the choke cover should become hot after a few minutes of engine operation. If the cover does not get hot, check for current at the cover terminal. The engine must be running. Trace down any opens or shorts.

Remove the choke cover to inspect the heating element and coil. See that the element is not burned out or broken. The bi-metal coil must not be damaged, dragging in the housing, or have an improperly directed spiral.

When installing a new coil, maintain the original direction of spiral inward from the fastening screw. Be sure the coil sets squarely in the housing so it will not bind. Coil should not touch inside of choke body.

FIXED SPEED GOVERNOR

Before making governor adjustment, run, the engine about 10 minutes to reach normal operating temperature. Be sure carburetor load and idle needles are properly adjusted before checking or adjusting governor system. For an accurate governor adjustment, a reliable tachometer is required.

WARNING ***Contact with rotating machinery might cause serious personal injury or death. Stay clear of rotating components and ensure that protective shields and guards are in place and secured before operating machinery.***

Be sure to clean, check, and lubricate goveror linkage (steel ball joints) before making any adjustments. Binding in the linkage joints can cause erratic operation. Some early models used plastic ball joints which require no lubrication.

If the following checks do not remedy erratic operation, install a new governor spring. Springs become fatigued with age.

Governor and vacuum booster control engine speed (Figure 13). Rated speed and voltage appear on nameplate. On a 4 pole generator engine speed divided by 30 equals frequency.

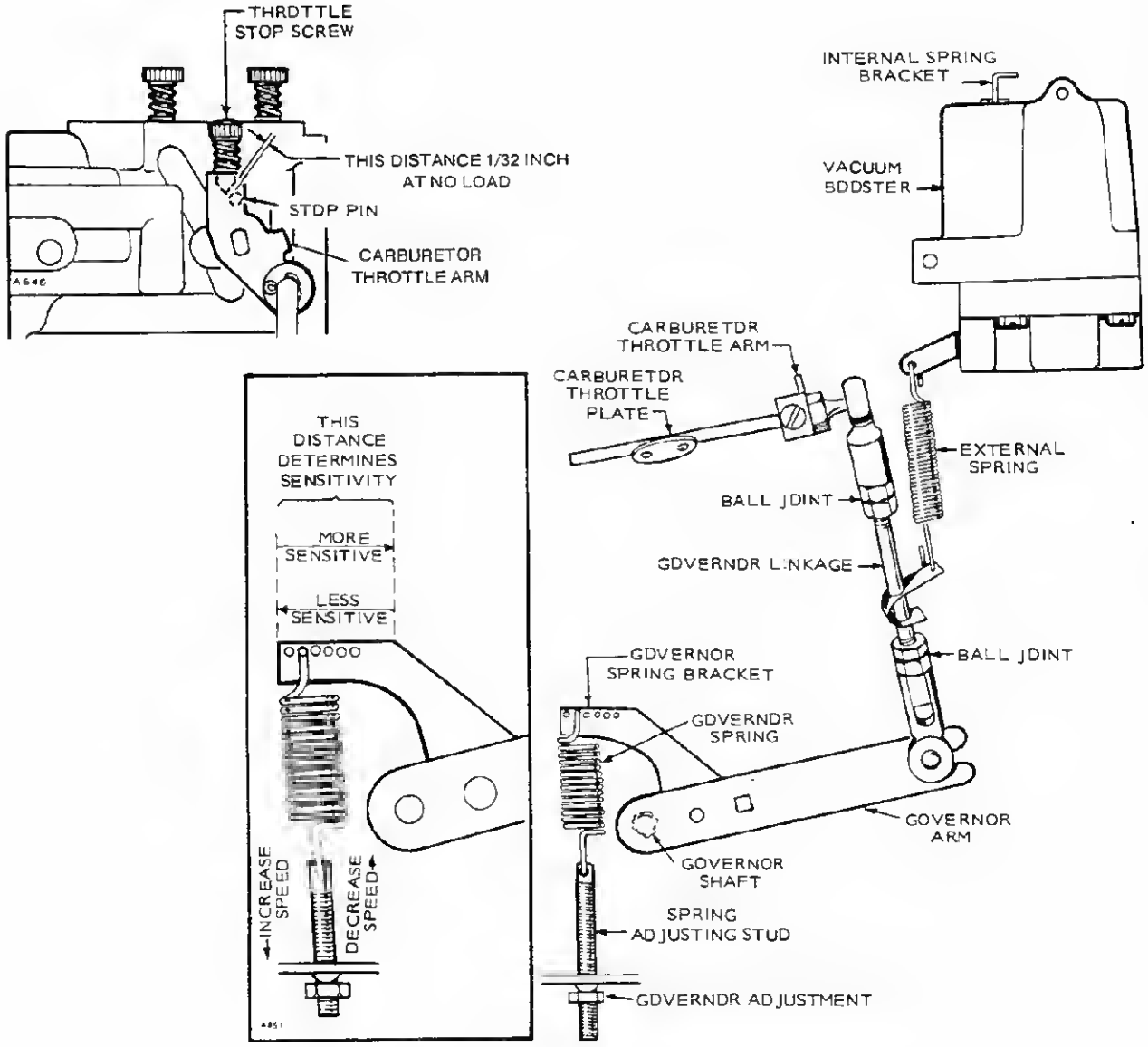


FIGURE 13. GOVERNOR AND GOVERNOR ADJUSTMENTS

Thus, 1800 rpm gives a 60 hertz frequency, and 1500 rpm gives 50 hertz frequency.

Preferred speed varies approximately 3 hertz from no-load to full-load operation. Be sure throttle, linkage, and governor mechanism operate smoothly.

Linkage

The engine starts at wide open throttle. Length of linkage connecting governor arm to throttle arm is adjusted by rotating the ball joint. Adjust length so that with engine stopped and with tension on governor spring, the stop screw on carburetor throttle lever is 1/32 inch from the stop pin. This setting allows immediate control by the governor after starting, and synchronizes travel of governor arm and throttle shaft. See Figure 13.

Speed Adjustment

1. Start engine and allow to warm up without load.

WARNING ***Inhalation of exhaust gases might result in serious personal injury or death. Be sure deadly exhaust gas is piped outside and away from windows, doors or other inlets to building.***

2. Remove vacuum booster external spring from bracket slide on the governor link (Figure 13).
3. Refer to voltage and speed charts. If needed, increase speed by increasing tension on the governor spring. Decrease tension on the governor spring to reduce speed.
4. Add a full-rated load to the engine and compare lower speed and voltage with those shown in the charts. If operation does not remain within these limits, check governor linkage and governor spring, and, if necessary, follow preceding procedure again.
5. Check and, if necessary, adjust governor sensitivity (see *Sensitivity Adjustment*).

Sensitivity Adjustment

1. Start engine and allow to warm up.
2. Check voltage and speed, first without load and then with a full load. See voltage and speed charts.
3. Increase sensitivity (closer regulation) by shifting adjusting clip toward governor shaft (Figure 13). Move clip away from governor shaft to decrease sensitivity.

   Too much sensitivity causes engine to hunt. Too little sensitivity results in too much speed difference between no-load and full-load conditions.

4. A change in sensitivity adjustment usually requires a compensating speed adjustment (spring tension). Then proceed to vacuum booster adjustment.

Vacuum-Booster Adjustment

1. After sensitivity adjustment, connect booster external spring to slide on governor link (Figure 13a).
2. With engine running at no-load, move adjustable slide to point where there is no tension on spring.
3. Apply full-rated load to engine.
4. If speed increases more than at no-load, lessen internal spring tension of the booster. To change tension, pull out spring bracket and move the pin to a different hole (Figure 13a). If speed decreases when load is applied, increase internal spring tension of the booster.

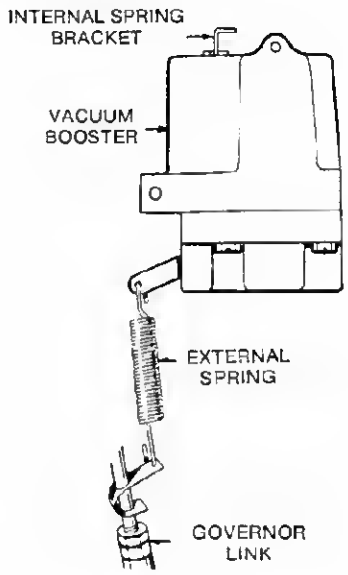


FIGURE 13a. VACUUM BOOSTER

SPEED CHART FOR CHECKING GOVERNOR REGULATION

AC GENERATING SETS	60 HERTZ	50 HERTZ
Maximum No-Load Speed		
RPM	1890	1560
Frequency (Hz)	63	52
Minimum Full-Load Speed (Without Booster)		
RPM	1770	1490
Frequency (Hz)	59	49

VOLTAGE CHART FOR CHECKING GOVERNOR REGULATION

AC GENERATING SETS	120 VOLT (1 PH . 2 W) OR 120/240 V (1 PH. 3 W)	240 VOLT (1 PH. 2W) OR 240 VOLT (3 PH. 3W)
Maximum No-Load Volts	126	252
Minimum Full-Load Volts (Without Booster)	110	220

NOTE: Output rating is at UNITY power factor load.

Ignition System

The engine is equipped with an automotive type battery ignition system. Both spark plugs fire simultaneously, thus the need for a distributor is eliminated. The major components of the ignition system are: the spark plugs, coil, breaker points and condenser. The MCCK ignition system is shielded to prevent radio interference.

IGNITION COIL

To test primary and secondary windings within the ignition coil proceed as follows:

1. Use a Simpson 260 VOM or equivalent.
2. Place black lead on ground (-) terminal of coil and red lead to positive (+) terminal. Primary resistance should read:

   RCCK 3.87—4.73 ohms
   MCCK 1.00—1.10 ohms.
3. Change resistance setting on ohmmeter. Place ohmmeter leads inside of spark plug cable holes (Figure 14). Secondary resistance should read:

   RCCK 12,600—15,400 ohms
   MCCK 10,800—13,200 ohms.

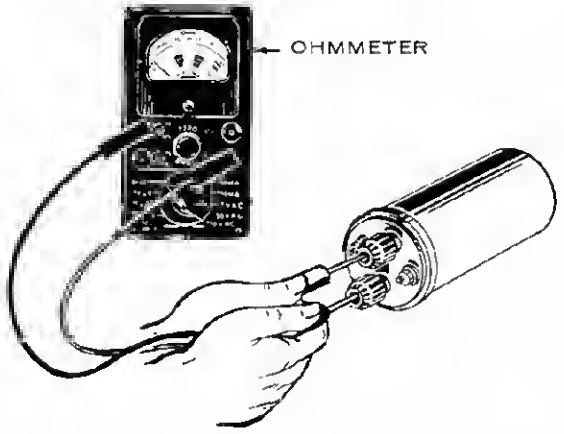


FIGURE 14. TESTING IGNITION COIL

4. If any of the above conditions are not met, replace coil. Refer to *PARTS CATALOG* for correct part number.

BREAKER POINTS

The timing is adjusted during initial engine assembly and is fixed by the point gap adjustment. To maintain maximum engine efficiency, change the breaker points every 200 hours of operation.

1. Remove two screws and cover on breaker box.
2. Remove both spark plugs so engine can be easily rotated by hand. If plugs have not been changed within last 100 hours, replace them with new ones after setting breaker points.
3. Remove two mounting screws (A) and pull points out of box just far enough so screw B can be removed. See Figure 15. Replace points with a new set but do not completely tighten mounting screws (A).
4. Rotate crankshaft clockwise (facing flywheel) by hand until points are fully open. Turn screw (C) until point gap measures 0.020 inch (0.51 mm) with a flat thickness gauge.
5. Tighten mounting screws and recheck gap.
6. Proceed to *Ignition Timing*.

Each time new breaker points are installed, place a drop of oil on the breaker arm pivot.

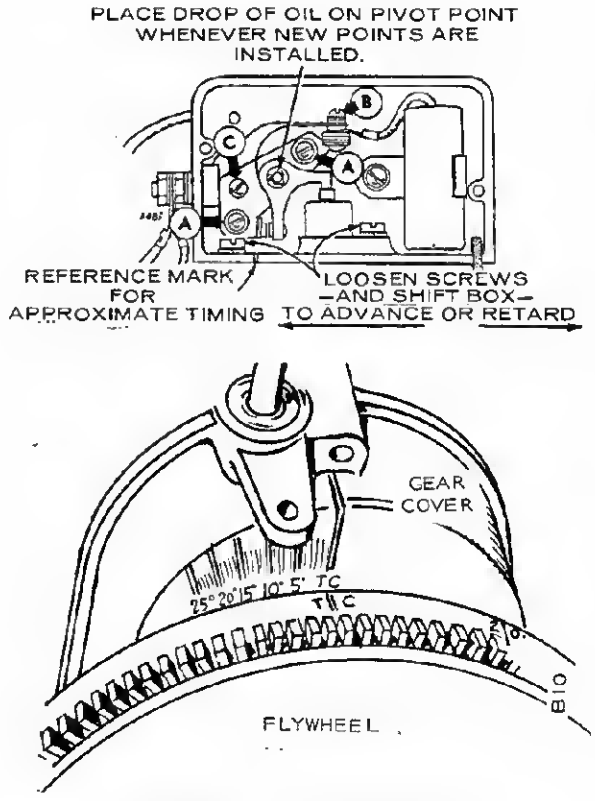


FIGURE 15. IGNITION TIMING

IGNITION TIMING

Ignition Timing — Engine Running

Always check timing after replacing ignition points or if noticing poor engine performance. Proceed as follows:

1. To check ignition timing accurately, use a timing light when engine is running. Connect timing light according to manufacturer's instructions. Either spark plug can be used as they fire simultaneously.

2. Place a white chalk or paint mark on flywheel TC mark.
3. Start engine and check timing. The TC on flywheel should line up with correct timing mark (20° BTC).
4. If timing needs adjustment, loosen breaker box mountings screws and move left to advance or right to retard timing (when facing rear of engine).
5. Be sure mark on flywheel lines up with correct timing mark.
6. Replace breaker box cover and any other hardware removed.

Ignition Timing — Engine Not Running

1. Connect a continuity test lamp set across ignition breaker points. Touch one test prod to breaker box terminal to which the coil lead is connected and touch other test prod to a good ground on engine.
2. Turn crankshaft against rotation (counterclockwise) until points close. Then slowly turn crankshaft with rotation (clockwise).
3. Lamp should go out just as points open (20° BTC) and ignition occurs. Timing marks should align.
4. If timing needs adjustment, loosen mounting screws on breaker box and move left to advance or right to retard timing (when facing rear of engine).

SPARK PLUGS

Check, and regap spark plugs every 100 hours of operation (Figure 16). Replace spark plugs that show signs of fouling or electrode erosion.

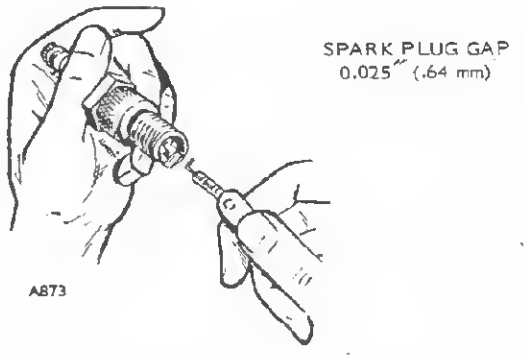


FIGURE 16. SPARK PLUG GAP

Battery Charging System

BATTERY CARE

Check battery cells with a hydrometer. The specific gravity reading should be approximately 1.260 at 77°F (25°C).

If one or more cells are low on water, add distilled water and recharge. Keep the battery case clean and dry. An accumulation of moisture will lead to a more rapid discharge and battery failure.

Keep the battery terminals clean and tight. Push the cable terminal down flush with or slightly below the top of the battery post. After making connections, coat the terminals with a light application of petroleum jelly or grease to retard corrosion.

Poor contact at the battery cable connections is often a source of trouble. Make sure battery cables are in good condition and that contacting surfaces are clean and tightly connected. Do not reverse battery leads. Use recommended battery tools when disconnecting leads to avoid mechanical battery damage.

WARNING ***Ignition of explosive battery gases might cause severe personal injury. Do not smoke while servicing batteries.***

BATTERY CHARGING, ALTERNATORS

The flywheel alternator is a permanent magnet alternator and uses a solid-state voltage regulator-rectifier for controlling output. Figures 17 and 18.

Weak ignition spark or a discharged battery indicate trouble in the charging system. But before testing the charging system, always check the battery for serviceability.

Keep these points in mind when testing or servicing the flywheel alternator:

1. Be sure output control plug (connector) is inserted properly. The plug must bottom in receptacle—eliminates any resistance due to a poor connection. Keep clean and tight.
2. Make sure alternator stator leads are not shorted together.
3. Be sure regulator-rectifier output control has a good ground connection. Mating surface for mounting must be clean and fasteners tightened properly.
4. Never reverse the battery leads.

Charging system tests require a fully charged battery.

15 AMP FLYWHEEL ALTERNATOR SYSTEM

The 15 amp system has two white wires coming from stator and is used on 3600 rpm engines. See Figure 17.

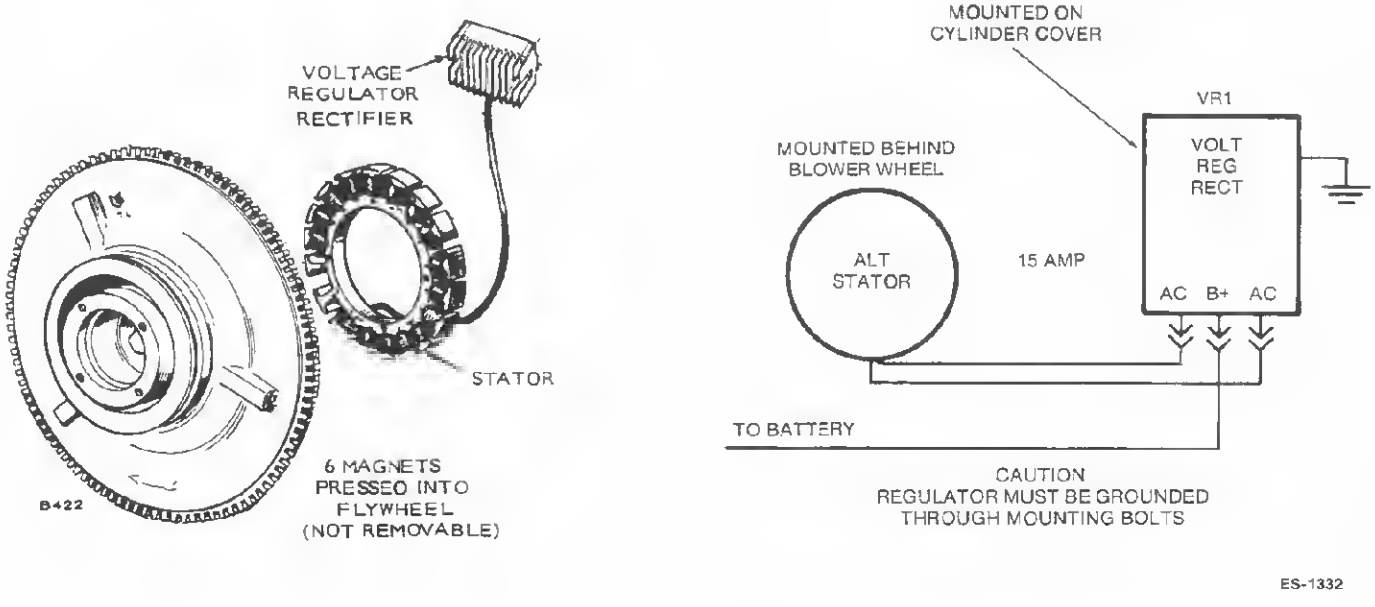


FIGURE 17. 15 AMP SYSTEM

TESTING PHELON 15 AMP SYSTEM

BASIC TEST	PROCEDURE	TEST VALUES
1. Battery	Battery Voltage - unit not running.	12 VDC
2. Regulator	Battery Voltage after unit is running 3 to 5 minutes.	13.6 to 14.7 VDC
3. Alternator Stator and Wiring	Ohmmeter reading from stator output, unit not running. Check at plug.	0.11 to 0.19-Ohms
4. Alternator and Wiring	Measure AC open circuit stator voltage with unit running. Measure between two stator leads with plug disconnected and unit running at approximately 3600 rpm.	28 VAC minimum 65 VAC maximum

20 AMP FLYWHEEL ALTERNATOR SYSTEM

The 20 amp flywheel alternator systems use a separate regulator and a separate rectifier. Figure 18. Two black wires and one red wire come from the stator assembly.

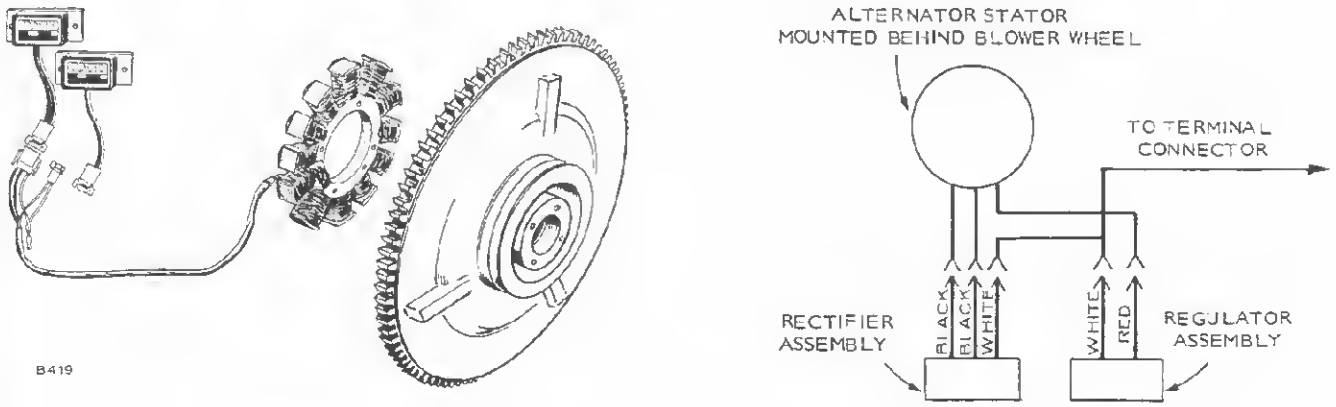


FIGURE 18. 20 AMP SYSTEM

TESTING ALTERNATOR

For testing this system, use a voltmeter-ohmmeter such as a Simpson 270. Listed below are various alternator problems with individual test procedures following.

No Output - Stator Assembly

Examine leadwires for loose or broken connections at the regulator and rectifier. Use the Rx1 scale on the ohmmeter for detecting opens in the stator. Disconnect the three wires that come from alternator stator (two black, one red). Connect ohmmeter test leads to red leadwire and ground to check continuity. The ohmmeter reading should be about 2.0-ohms. See Figure 18.

Next connect meter to black leadwires and ground. Approximately 0.1-ohm should be read from either black lead to ground. If no connection exists between ground and black leads, stator assembly should be replaced.

Checking Rectifier Assembly

Examine each of the two diodes for breakdown by connecting ohmmeter (Rx1 scale) to one black lead and to the white lead. Meter should read 10-ohms in proper polarity. A shorted diode would read zero resistance and would cause a short circuit through the lead winding when in operation. An open diode would read infinite in both directions, indicating that replacement is necessary.

TESTING REGULATOR ASSEMBLY

To check for proper voltage regulation, attach a DC voltmeter to battery and operate engine at approximately 1800 rpm. Battery voltage will climb to the present factory setting (14.2 to 14.8 volts).

Some installations may vary due to voltage drop in the length of ammeter harnesses. Other variations may stem from a loose connector in the harness or loose or corroded battery leads. Low voltage readings at the battery mean poor battery connections.

To test regulator, remove connector. Using the Rx10,000 scale of the ohmmeter, connect one meter lead to red leadwire and other meter lead to regulator base. See Figure 18. No deflection should be noted on the ohmmeter in either polarity. Next connect meter to black leadwire and base of regulator. Meter will deflect fully in one polarity, with no deflection in the other.

Full Charge - Will Not Regulate

Check for broken leads at connection to regulator plates. To be sure regulator winding operates properly, connect red lead to ground and start engine. A maximum of 4 amperes should be noted. This would indicate stator winding is satisfactory. If so, replace regulator.

No Charge

If alternator does not charge when load is applied to battery, shut off engine and disconnect one red leadwire from regulator terminal. Be sure lead is taped or isolated from conducting engine parts. Once again, start engine. Alternator should charge to full output; if it doesn't, replace stator assembly.

TESTING 20 AMP SYSTEM

TEST	VALUE
Battery voltage - unit not running.	12 Volts DC
Battery voltage with unit running at 1800 rpm or more.	14.2 - 14.8 Volts DC
AC voltage from stator with plug disconnected and unit running at approximately 1800 rpm.	23 VAC minimum* Black to Black
Ohmmeter reading at plug when checking two AC stator leads - unit not running.	0.5 to 0.7-Ohms** Black to Black

* - 48 VAC maximum at 3600 rpm. Red to Ground.
** - Resistance values (Ohms) are as follows between wire pairs.

Oil System

The engine has pressure lubrication to all working parts. The oil system includes:

- Oil intake cup
- Gear type oil pump
- Oil pressure gauge
- Oil passages to deliver oil throughout engine
- Oil filter (if used)

WARNING ***Crankcase pressure could blow out hot oil and cause serious burns. Do NOT check oil while the engine is operating.***

The oil pump is located on the front surface of the crankcase and is driven by the crank gear. The inlet pipe and screen assembly attach directly to the pump body. Figure 19. A discharge passage in the cover of the pump registers with a drilled passage in the crankcase. Parallel passages distribute oil to the front main bearing, rear main bearing, and pressure control bypass valve.

Circumferential grooves in the main bearings supply oil to the connecting rod bearings through drilled passages from each main journal.

A drilled passage connects the front main bearing oil supply to the front camshaft bearing. The flyball governor is lubricated by a drilled passage in the front camshaft journal.

The oil overflow from the bypass valve furnishes lubrication to the camshaft drive gears.

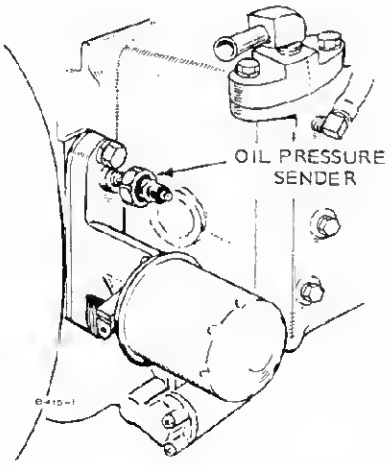


FIGURE 20. OIL PRESSURE

Normal oil pressure should be 30 psi (207 kPa) or higher when the engine is at operating temperature. If pressure drops below 30 psi (207 kPa) at governed speed, inspect the oil system for faulty components.

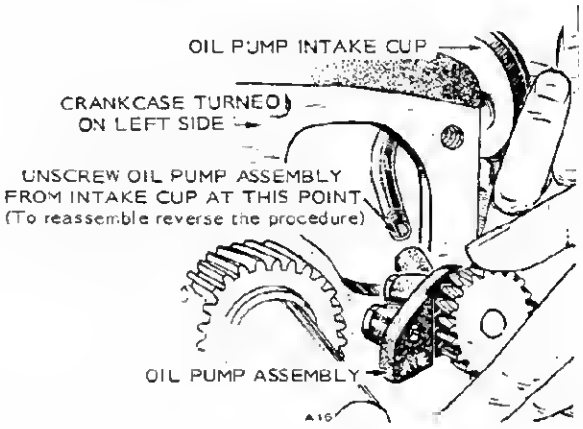


FIGURE 19. OIL PRESSURE PUMP ASSEMBLY

OIL BYPASS VALVE

The by-pass valve (located to the right and behind gear cover), controls oil pressure by allowing excess oil to flow directly back to the crankcase. Normally the valve begins to open about 30 psi (207 kPa).

The valve is non-adjustable and normally needs no maintenance. To determine if abnormal (high or low) oil pressure is caused by a sticky plunger inspect as follows:

1. Remove 3/8 x 24 x 3/4 cap screw located behind gear cover and under governor arm.
2. Remove spring end plunger with a magnet tool. Clean plunger and spring with a suitable solvent and install.

CRANKCASE BREATHER RCCK AND MCCK (Begin Spec B)

These engines are equipped with a crankcase breather for maintaining crankcase vacuum. Clean the crankcase breather cap and valve assembly and the breather tube baffle in a suitable solvent every 300 operational hours. To remove breather cap and valve assembly, remove breather hose clamp and breather tube clamp. See Figure 21.

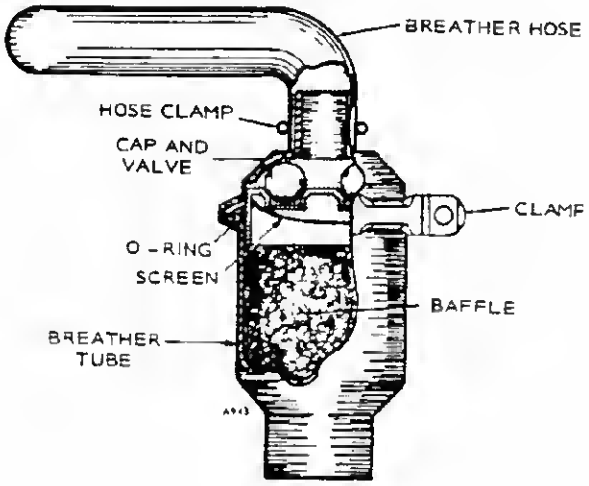


FIGURE 21. CRANKCASE BREATHER

CRANKCASE BREATHER MCCK (Spec A Only)

Lift off rubber breather cap. Carefully pry valve from cap. Otherwise, press hard with both of your thumbs on top of cap and keep fingers below to release valve from rubber cap. Wash this fabric, flapper-type check valve in a suitable solvent. Dry and install. Position perforated disc toward engine. See Figure 22.

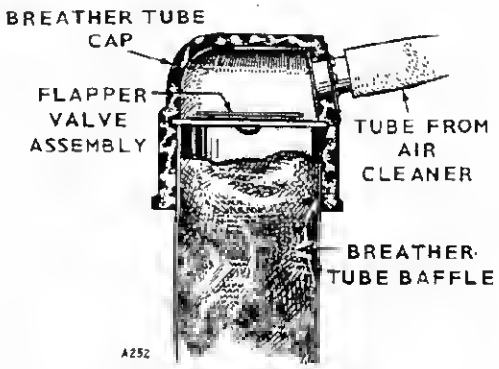


FIGURE 22. CRANKCASE BREATHER MCCK SPEC A ONLY

RCCK Cooling System

DESCRIPTION

The RCCK cooling system is a closed system which uses an engine mounted pump to draw and circulate coolant through the engine and radiator.

Water from the radiator enters the pump located on the front of the engine. The pump delivers water to the cylinder jacket and it flows through the jacket and out of the cylinder heads to the radiator. The water flow is controlled by thermostats. For engine warm-up, with thermostats closed, a by-pass between the cylinder heads allows water flow.

MAINTENANCE

Cooling system maintenance includes periodic inspection for leaks, and flushing and cleaning.

FLUSHING

The cooling system must be kept clean to function properly. Scale reduces heat transfer and restricts water flow. Flush the system at least once a year and more often if operation indicates clogged passages, pump wear, or overheating.

To flush the engine, remove both thermostats, Figure 23. Attach a flushing gun nozzle to the thermostat opening and fill the block with water; then apply air pressure. Repeat the process until water coming from the block is clean.

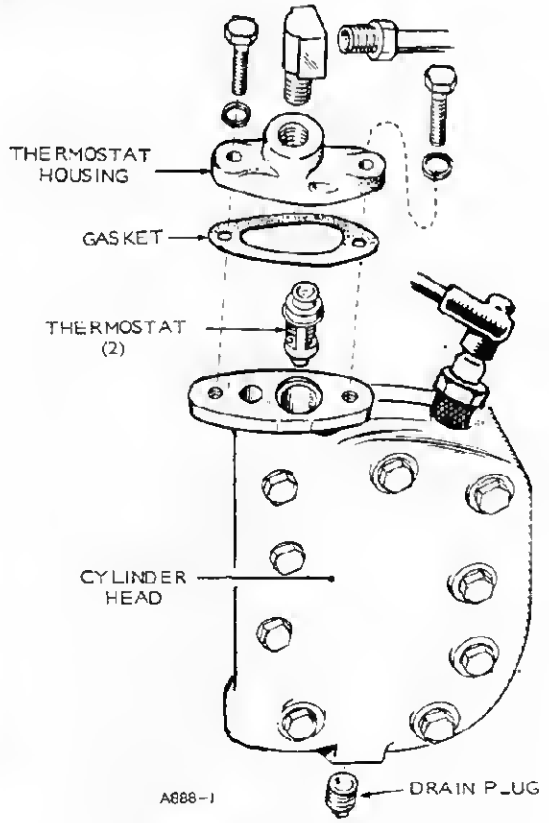


FIGURE 23. THERMOSTAT REMOVAL

CLEANING

To clean the cooling system, drain and fill with radiator cleaner. When chemical cleaning is done, always flush the cooling system to wash out deposits loosened by the chemical cleaning. Flush the engine water jacket as previously discussed. When flushing is completed, check the system thoroughly for leaks.

REPAIR

When making cooling system repairs, use Permatex or other thread-sealing compound on all threaded connections.

All water lines should be 1/2 inch (13 mm) inside diameter or larger. Long runs of pipe or hose need a larger inside diameter to reduce resistance.

Water Pump: Refer to centrifugal pump repair in *MCCK COOLING SYSTEM* for repair procedures.

Thermostats: A thermostat is located on the top of each cylinder head. Replace thermostats that are damaged from corrosion or other causes.

Check opening and closing by placing the thermostat and a thermometer in heated water. The thermostat should start to open at 175° F (70° C) and be fully open at 202° F (94° C). It should close immediately when removed from hot water. Replace the thermostat if it does not operate properly.

High Water Temperature Cut-off Switch: This normally closed switch (Figure 24) senses water temperature in the engine cooling jacket. The switch opens, breaking the circuit to the coil primary when the water temperature reaches about 230° F (110° C) and closes when the temperature drops below 190° F (88° C).

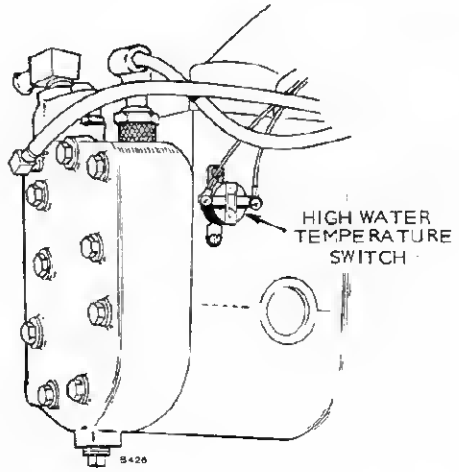


FIGURE 24. HIGH WATER TEMPERATURE SWITCH

MCCK Cooling System

DESCRIPTION

The MCCK cooling system is a pressure type system which uses an engine mounted rubber impeller pump to draw and circulate raw water throughout the system.

In open type cooling systems, water enters the pump located on the front right side of engine. The pump delivers water to the cylinder jacket. Water flows through the jacket and out openings in cylinder heads controlled by thermostats. For engine warm-up, with thermostats closed, a by-pass from the cylinder block to the thermostat allows water flow. From thermostat, water passes through the water-cooled exhaust manifold and out engine cooling system.

MAINTENANCE

Cooling system maintenance includes periodic inspection for leaks, inspection of the rubber pump impeller, and flushing and cleaning.

WARNING ***Contact with hot coolant might result in serious burns. Do not bleed hot, pressurized coolant from a closed cooling system.***

The rubber impeller, because of continuous flexing, will, in time, need replacement. If impeller fails after short service (usually under 500 hours), check for possible defects, such as severe pitting or abrasion caused by dirt in the cooling system.

Cooling system MUST be kept clean to function properly. Scale reduces heat transfer and restricts water flow. Flush system at least once a year and more often if operation indicates clogged passages, pump wear, or overheating.

To flush engine, remove the thermostats, Figure 25 and the water pump cover. Partially restrict pump opening so the cylinder block fills with water. Attach a flushing gun nozzle to thermostat opening and fill block with water; then apply air pressure. Repeat the process until water coming from the block is clean.

TESTING

Cooling system can be tested for two abnormal conditions: (1) insufficient water flow and (2) air leaks.

1. To measure water flow, install a tank of known capacity at the water outlet. Run engine until the thermostat opens and then measure the length of time necessary to fill the tank. From this, obtain the flow in gallons per minute (GPM). If water flow is below 3.5 GPM, check pump operation and inspect passages and water lines for clogging.

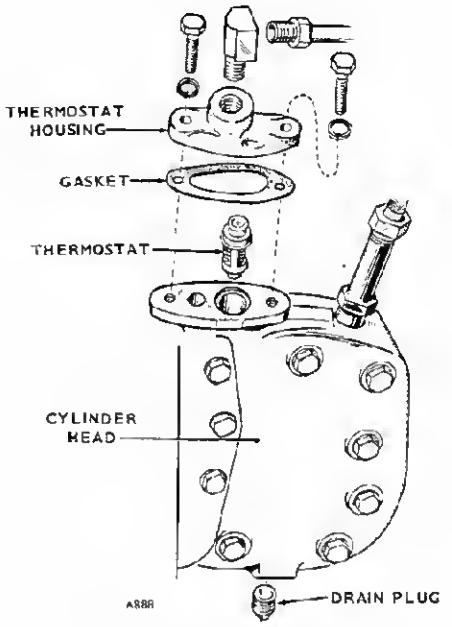


FIGURE 25. THERMOSTAT REMOVAL

2. Air leaks will cause premature impeller failure. To test for air leaks, insert the cooling system outlet into a tank of water and watch for bubbles while engine is operating. If bubbles appear, inspect cooling system thoroughly to find the source.

REPAIR

When making cooling system repairs, use Permatex or other thread-sealing compound on all threaded connections.

All water lines should be 1/2 inch or larger inside diameter. Long runs of pipe or hose need a larger inside diameter to reduce resistance.

THERMOSTATS

Thermostats are located on the top of each cylinder head. These are connected by tubing to the water-cooled manifold. Replace all thermostats that are damaged (from corrosion or other causes). See Figure 25.

Check opening and closing by placing the thermostat and a thermometer in a water bath. The thermostat should start to open at 145°F and be fully open at 165°F. It should close immediately when removed from hot water. Replace the thermostat if it does not operate properly.

HIGH WATER TEMPERATURE CUT-OFF SWITCH

This normally closed switch senses water temperature in the engine cooling jacket. The switch opens, breaking the circuit to the coil primary when the water temperature reaches approximately 200° F and closes when the temperaure drops below approximately 160° F.

WATER PUMP

This pump is a positive displacement, neoprene impeller type, used to pump raw water through the cooling system.

Disassembly (Pump 131-0165)

1. Remove the pump end plate screws, end plate, and gasket as shown in Figure 26 (Step a).
2. Pull out neoprene impeller with a pair of pliers (Step b).
3. If further disassembly is required, disconnect the hoses and remove the two capscrews holding the pump to the engine (Step c). Lift pump from engine.
4. Loosen the set screw on the side of the pump and tap it lightly to free the cam from the pump body. Lift out cam and wear plate (Step d).
5. Remove the retaining ring (using a screwdriver) as shown in Step e and slide the seat assembly (O-ring and ceramic seal) off the pump shaft.
6. Pry the bellows assembly out of the pump body by inserting a screwdriver through the drain slots (Step f).
7. Drive the shaft and bearing assembly out of the pump body using a bearing driver or press. The bearing is press fit on the shaft and comes off in one integral part.

Assembly (Pump 131-0165)

Inspect the pump housing for wear, rough surfaces, or pitting and replace if any of these conditions exist. Replace any other worn components such as bearings, seals, or impeller and use a new end plate gasket.

1. Apply sealing compound to the sealing lip around the edge of the bellows seal. Place the bellows seal in the pump body and drive it into place (Step g).
2. Apply a small amount of Loctite or eqivalent on the outside surface of the bearing (Step h).
3. Place the bearing and shaft assembly in the pump bore and drive into place (Step i). Strike outer race only to avoid damage to pump shaft and bearing.
4. Lubricate both sides of the seat assembly (ceramic seal and O-ring) with lubricating oil and slide assembly over pump shaft. The ceramic portion of the seat assembly should contact the bellows. Compress the seat assembly against the bellows and at the same time push the retaining ring into its groove on the pump shaft.
5. Place wear plate and cam so notch in wear plate lines up with tank on cam (Step j). Fasten cam to housing with screw.
6. Align the flat spot in the center of the impeller with the flat spot on the pump shaft. Bend back the impeller blades nearest the cam and push the impeller onto the shaft. Do not remove the factory coating of oil from the new impeller before installing.
7. Install the pump end plate using a new gasket and tighten end plate screws to 15-17 in-lb (1.7-1.9 Nm).
8. Install pump on engine (Step k) and attach hoses.

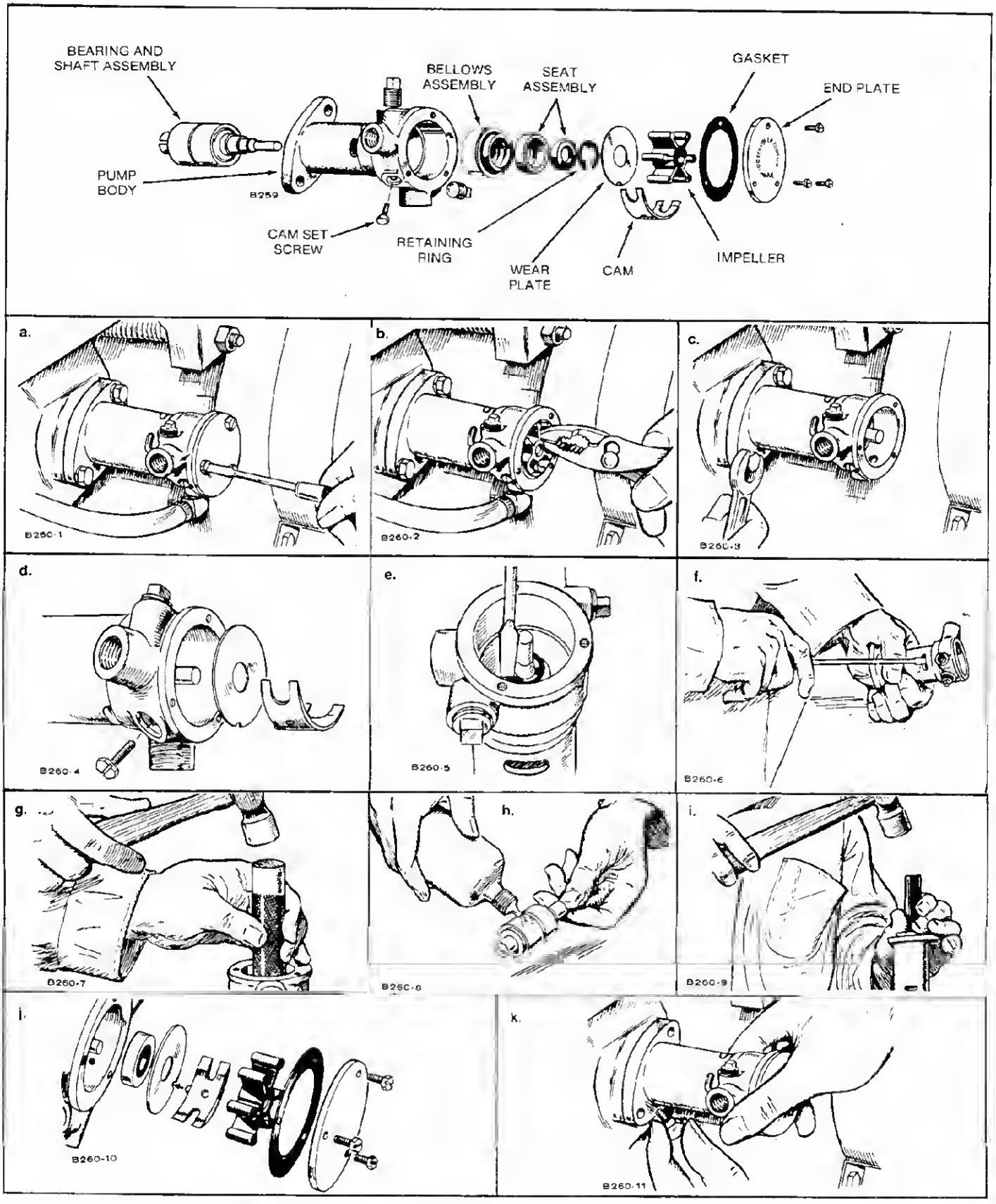


FIGURE 26. PUMP 131-0165